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Title: Estimation of Salt and Fresh Water Transports in the Bay of Bengal

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LONG-TERM GOALS

The importance of Indian Ocean circulation dynamics to the regional and global weather signatures is increasingly recognized at large partly due to improved ocean observations in the last few decades. Observational and modeling efforts are directed towards understanding the impact of intraseasonal variability and interannual variability on the monsoon variability. A key component of better understanding for the region is the resolving of salt transport within a dynamic freshwater flux environment. The freshwater influx leads to intense salinity stratification in the regions like the Bay of Bengal (BoB) and helps maintain warmer surface temperature.

OBJECTIVES

1) To estimate the inter-basin exchange of salt in the tropical Indian Ocean and delineation of pathways of high/low salinity water-masses.
2) Study of role of salinity on the barrier layer dynamics in the Bay of Bengal.

APPROACH

In this study we will used the global HYbrid Coordinate Ocean Model (HYCOM) with a horizontal resolution of 1/12° (~7 km at mid-latitudes) and 32 hybrid layers in the vertical. The hybrid coordinate system is isopycnal in the open, stratified ocean, but smoothly reverts to a terrain-following coordinate in shallow coastal regions, and to a pressure coordinate in the mixed layer and/or unstratified seas. This is an advantage because no single coordinate system is optimal everywhere. A fine resolution global model is needed for this work because of the global nature of the problem we plan to study and because recent research has shown the importance of high horizontal resolution for the accurate representation of many key features of the Indian ocean, features which can and do impact ocean salinity. The model is configured on a Mercator grid from 78°S to 47°N, with a bipolar grid used north of 47°N. In this study we used daily global HYCOM simulations to estimate salt and frssh water transports in the Indian Ocean.

WORK COMPLETED

In the last 4 months of this project we ran the HYCOM simulations during 2003-2006 (4 years) and estimated the seasonal variability of salinity transport in the Indian Ocean is investigated using the high resolution global HYbrid Coordinate Ocean Model (HYCOM). Mechanisms and physical parameters that control the salinity budget are examined. We have published a journal article in Journal of Geophysical Research (Nyadjro et al., 2011). Two more journal papers are in preparation.

RESULTS

We used 4-year HYCOM simulations (2003-2006) are used to study the transport of salinity in the surface layers of the Indian Ocean and to estimate the flux of salt in the 32 HYCOM layers using depth-integrated transport methods. Results (Nyadjro et al., 2011) show the influence of freshwater forcing and zonal advection as the dominant mechanisms of Sea Surface Salinity (SSS) variability in the Indian Ocean. Precipitation is highest in the eastern Bay of Bengal (BoB) where it shows seasonal variation and in the south equatorial eastern Indian Ocean (EIO) where it was consistently high year round. These patterns result in significant seasonal variation in the SSS in the BoB and almost no variation in the EIO. Zonal SSS transport was higher than meridional SSS transport with the strongest seasonality observed along the Sri Lankan region. Results of depth integrated transport shows northward salt transport in the bottom layers and a southward salt transport in the surface layers (Figure 1). The 4-year mean net flux of depth-integrated salt transport was southward (-154.8×10^6 kg/s to -552.4×10^6 kg/s) at all latitudes except at 20°N where it was northward (396×10^6 kg/s). Transport generally increases southward with the highest transports occurring in the south (10°S-35°S) and a maximum at 30°S. Analyses of meridional Ekman volume and salt transport show a predominantly southward transport, an indication of the strong influence of SW monsoonal winds. Overall, there is a net southward flux of salt in almost all latitudes of the Indian Ocean with patterns reflecting the transport of water masses and currents in the Ocean.

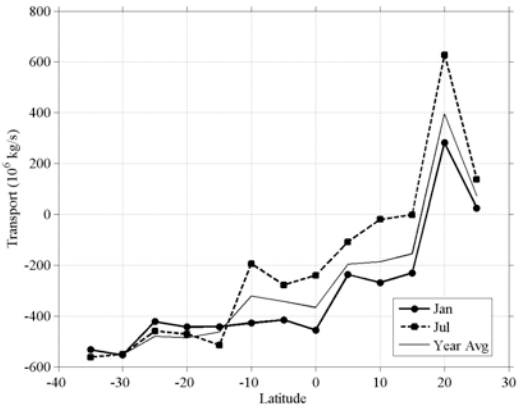

Figure 1. Seasonal variation of net depth integrated meridional salt transport in the Indian Ocean computed from 4-year mean (2003-2006), January and July simulations.

IMPACT/APPLICATIONS

This study illustrates that the HYCOM output is useful for calculating Indian Ocean salinity transport and should be useful in computing near-surface salt transport from the Soil Moisture and Ocean Salinity (SMOS) and Aquarius satellite missions as well.

RELATED PROJECTS

None

PUBLICATIONS

Nyadjro, E.S., B. Subrahmanyam, and J.F. Shriver (2011). Seasonal Variability of Salt Transport during the Indian Ocean Monsoons, *Journal of Geophysical Research*, 116, doi:10.1029/2011JC006993.